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Third International Virtual Workshop on Global Seismology and Tectonics (IVWGST-2022)

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Abstract:

The third International Virtual Workshop on Global Seismology and Tectonics (IVWGST) was hosted virtually from 20th-30th September, 2022 by the Geosciences and Technology Division of the CSIR-North East Institute of Science and Technology (CSIR-NEIST), Jorhat via Microsoft Teams With thirteen speakers from various leading geo-scientific institutes around the globe, the virtual platform was further adorned by 528 participants from nearly 17 different nations. The speakers delivered lucid lectures in context of their research interests in the domain of seismology and tectonics. IVWGST-2022 aimed at providing researchers and students the opportunities to interact with eminent personalities for exploring avenues of geo-scientific study in numerous multidisciplinary aspects.

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A brief account:

The widespread influence of the global pandemic has prompted the closure of various institutions and organisations posing a fatal threat to mankind thus resulting in the emergence of e-learning[1]. Workshops assist in establishing a network between learners and prominent personalities of their respective field of interest[2]. This enables the young research aspirants to explore the future prospects of research areas in which they are keenly interested. Digitisation during the Covid era has also come up with remarkable productive outcomes in the domain of research and development. Attending

conferences and workshops have always been an integral part of academics and adoption to online platforms has facilitated it even further[3].

With the aim of imparting knowledge in relevance to the occurrence of various geophysical phenomena and seismic events, their underlying causes and outcomes, the first edition of International Virtual Workshop on Global Seismology and Tectonics was successfully conducted from 14th – 25th September, 2020(IST)[4] and subsequently, the 2nd edition was organised from 20th-30th September, 2021(IST). The initial two editions of IVWGST provided extensive scopes for knowledge dissemination especially in the field of seismology and tectonics.

The 3rd International Virtual Workshop on Global Seismology and Tectonics was successfully conducted from 20th- 30th September, 2022 (IST) by the Geoscience and Technology Division, CSIR-NEIST, Jorhat with the prime objective of enlightening the undergraduates, postgraduates, research scholars and learners across the globe. The virtual workshop served as an interacting platform between learners and various renowned scientists in the realm of seismology and tectonics. The workshop was attended by nearly 528 national and international participants from different parts of the world. Remarkably, it witnessed an increase in the average number of attendees for each lecture session throughout the course of the entire workshop. This indeed implies the inquisitiveness among learners of different sections to know more about the scientific progresses made in the relevant field of seismology and tectonics.

Thirteen eminent speakers hailing from various esteemed institutions located across the world delivered lectures pertaining to a range of diverse themes and prevailing issues in context of global seismology and tectonics. The inaugural session commenced with a welcome address by G. Narahari Sastry (Director, CSIR-NEIST, Jorhat) followed by a few initial words from International Advisers Andrew J. Michael (United States Geological Survey (USGS)) and Dapeng Zhao (Tohoku University, Japan). J.R. Kayal (former Deputy Director General, Geological Survey of India, Kolkata) was the chairperson for every technical session held throughout the workshop. The Convener of the workshop Santanu Baruah (CSIR-NEIST) in his inaugural speech talked about the significance and objectives behind the conduction of IVWGST. The organizing committee further comprised of national advisers, session chairperson, session co-chairpersons, conveners, executive committee, local organizing committee and student committee. The committee members seamlessly indulged themselves in ensuring the successful execution of the event. The series of lectures by dignitaries emphasised on observations and findings based on case studies conducted at various seismic zones around the globe. Further, the keynote speakers prioritised their discussions on various aspects of seismology such as seismic structure and dynamics, deep drilling and downhole measurements to understand earthquake processes, causes of aftershocks, earthquakes at unexpected regions as a result of energy production, GNSS based Geoscience Research, earthquake hazard and risk analysis for natural and induced seismicity etc.

Shailesh Nayak **(**Director, National Institute of Advanced Studies (NIAS), India) delivered a talk on the topic "A Scientific Drilling in Koyna: An Experiment to Understand Triggered Earthquakes". In his lecture, he introduced the factors that trigger earthquakes which include – impounding of artificial water reservoirs, large scale surface and deep underground mining etc. Further, he extended the discussion to reservoir-triggered seismicity (RTS) and gave scientific explanation regarding the choice of Koyna as an ideal site for the study of RTS.

Abhijit Ghosh (University of California, USA) spoke about the "Structural Complexities that Control Rupture of the Himalayan Megathrust". In his discussion, he elucidated about the duplex structure on tectonic settings of the imbricate thrust faults present in Main Himalayan Thrust. The talk emphasised on the strong structural control over the Gorkha rupture along with the structural complexity to east affecting rupture propagation, with detailed discussion on how structure can play a crucial role in arresting the rupture that happened due to the Gorkha earthquake.

Jeanne Hardebeck (USGS, USA) presented a lecture on the topic "What causes Aftershocks?". In her discussion, she emphasised on interaction of stress changes and background stress to control aftershock mechanism, triggering of near-field aftershocks by both static and dynamic stress changes, etc.

Dapeng Zhao (Tohoku University, Japan) presented an overview of "Seismic structure and dynamics of the Japan subduction zone." He enlightened the participants by providing detailed description on the significance of tomographic imaging in the study of seismic velocity structure and the triggering of crustal earthquakes by fluids present in the crust and the uppermost mantle of subduction zones.

C.P. Rajendran (NIAS, India) delivered a talk on "The Medieval Pulse of Earthquakes in the Central Himalaya and the future seismic hazard in the region". His lecture was based on discussions of seismicity of the Himalaya and the concept of seismic gaps, earthquake generation models based on GPS geodesy, propagation of earthquake ruptures, etc.

Sukanta Roy (Director, Borehole Geophysics Research Laboratory (BGRL), Ministry of Earth Sciences (MoES), India) enlightened the participants on a very interesting topic entitled "Deep drilling and downhole measurements/monitoring to understand earthquake processes: a study from the Koyna seismogenic zone, India". He elucidated on the genesis of earthquakes in stable continental region, role of artificial water reservoirs in triggering earthquakes etc.

Margarita Segou (British Geological Survey, United Kingdom) presented a lecture on "The physics of earthquake interactions: Recent Advances Informed by Deep-Learning Catalogs". In her lecture, she described the improving performance of Coulomb Rate State (CRS) models using an increased number of attributes making real-time high res-catalog, estimation of event-specific triggering, etc.

Sumer Chopra (Director, Institute of Seismological Research (ISR), Gujarat, India) in his lecture on "Seismicity in intraplate Gujarat region" deliberated an intriguing talk on the long and short term deformation rates obtained from GPS network of ISR and the seismicity differences observed in the Kachchh , Saurashtra and Cambay rifts.

Sridevi Jade **(**Head, CSIR-Fourth Paradigm Institute (CSIR-4PI), India) in her talk on "GNSS based Geoscience Research in Indian Subcontinent" illuminated the participants on the use of Global Navigation Satellite System (GNSS) in seismic research. She further discussed on the utility of GNSS in ionosphere studies, strain rate analysis, etc.

Justin Rubinstein (USGS, USA) presented a talk on the topic of "Earthquakes in the Heartland: How Energy Production Causes Earthquakes in Unexpected Places". He demonstrated the results of case studies regarding the possible reasons behind Oklahoma being a hotspot for earthquake, emphasising on the idea of induced seismicity and the ways in which the oil and gas processes lead to the occurrence of such induced earthquakes as large as magnitude 4.5

Wiwit Suryanto (University of Gadjah Mada (UGM), Indonesia) presented an overview on "Crustal Anisotropy of Sumatra from Harmonic Decomposition of Receiver Function". His discussions focused on tectonics and crustal anisotropy of Sumatra describing the observed anisotropic alignment pattern to the Sumatran fault along with the significance of anisotropy tomography as a key tool in the study of subduction dynamics.

Sagarika Mukhopadhyay (Indian Institute of Technology- Roorkee, India) spoke about the "3-D Seismic Velocity Structure of the Lithosphere and its Geodynamic Implications for the Western Himalayas, Western Himalayan Syntaxis and Pamir-Hindu Kush Region". She described about the tomography of the complex western Himalayan Hindu - Kush region summarising the results obtained using tomographic techniques from a collection of large data sets that has enabled the study of deeper velocity structures and faults.

Julian J. Bommer (Imperial College, London, United Kingdom) in the final lecture entitled "Earthquake Hazard and Risk Analysis for Natural and Induced Seismicity: Towards Objective Assessments in the Face of Uncertainty" explained the distinctions between natural and induced earthquakes along with the observations and responses recorded from ground motion using a seismic risk model for estimation of induced seismicity.

All the speakers further elucidated the conclusions and significance of their specialised research interests, enabling the interested participants to understand the causes, prediction and ways of mitigating seismic hazards. The registration for the workshop was free of cost to facilitate the participation of maximum number of enthusiastic learners exploring the science behind dynamics

of the earth and associated seismic occurrences. Registered participants were provided with e-certificates after the completion of the workshop for their active participation. Participants were provided with the scope to raise or mail their questions to ensure detailed explanation of their queries from the respective subject experts.

In an exemplary way, IVWGST provided an enriching platform to inculcate a profound sense of geo-scientific learning amongst the aspirants, irrespective of the temporal or geographical variations. IVWGST, in addition, has been able to set a phenomenal standard in delivering an insight into the different aspects of Geosciences amongst earth scientists. The team of IVWGST envisages to work better strategies ensuring larger participation..

The lecture recordings have been made available via the official IVWGST Youtube channel (https://youtube.com/channel/UClm31leGJf1OdTZYj-SD_1w) to make the same accessible anywhere and anytime. With the creation of a co-existent learning ambience, team of IVWGST plans to elaborate the future agenda of the workshop by introducing quizzes, group discussions and more such interactive sessions besides the lectures; instilling a plethora of opinions and exchange of ideas amongst the attendees and the speakers. This would hopefully make the sessions more versatile and exhilarating, hence contributing to increased number of registrations in the upcoming editions to be held.

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